

REMARKS

Claims 1-4 and 6-30 are pending in the present application. Claims 1-4 and 6-30 are rejected under 35 U.S.C. § 103(a). Claims 1 and 21 are amended, and claims 31-33 are added. No new matter is added. The rejections are respectfully traversed in light of the following remarks, and reconsideration is requested.

Further, Applicants submit a new Power of Attorney and correspondence change. Please address any future correspondences in the above matter to the new address:

Tom Chen
MacPherson Kwok Chen & Heid LLP
2402 Michelson Drive, Suite 210
Irvine, CA 92612
Phone: (949) 752-7040
Fax: (408) 392-9262

Rejections under 35 U.S.C. § 103(a)

Claims 1-4 and 6-30 were rejected as being unpatentable over Papasouliotis (U.S. 6,030,881) in view of Perry et al. (U.S. 5,705,419). The Examiner writes, in part:

‘881 fails to expressly teach using a hydrogen-plasma chemical etch. Hydrogen plasma etches are well known in the art of semiconductor processing. ‘419 teaches that the use of a hydrogen plasma (hydrogen bromide) facilitates etching in a partial and controllable manner (see column 5, lines 21-37).

Perry et al. discloses using a hydrogen bromide gas and a chlorine gas to effect the plasma etch. (Perry, col. 5, lines 22-26; col. 7, lines 12-15). Perry also discloses an “etching plasma containing gases such as C₂F₆, CF₄ or CHF₃”. (Perry, col. 5, line 66 to col. 6, line 2; col. 6, lines 46-48).

In contrast, claim 1, as amended, recites “chemically etching said film in said gap with a hydrogen-only plasma”. Support for the amendment is found in Applicants’ specification at page 14, line 3 to page 15, line 11. Thus, no new matter is added. By using only hydrogen, in, for example, the chemical reaction SiO₂ + 2H₂ → SiH₄ + O₂, a slower and more

MacPHERSON, KWOK CHEN
& HEID LLP
2402 MICHELSON DRIVE
SUITE 210
IRVINE, CA 92612
(949) 752-7040
FAX (949) 752-7049

controlled chemical etch is possible with essentially only silane and oxygen as by-products, as disclosed in Applicants' specification at page 15, lines 11-21. This provides a repeatable clean etch process that is capable of filling high aspect ratio gaps. Further, if hydrogen were added to the halogen plasma, as suggested by the Examiner, the performance is reduced since the H₂ scavenges halogens from the plasma, resulting in reduced etching rate. Applicants contend that it is well known that with plasma etching with HBr plasmas, the active etching component is HBr, not hydrogen, as recited in claim 1. (See, e.g., "Effects of plasma conditions on the shapes of features etched in Cl₂ and HBr plasmas" by M.A. Vyvolda et al., in J. Vac. Sci. Technol. A 16(6), Nov/Dec 1998).

Thus, claim 1 is patentable over Papasouliotis in view of Perry because, *inter alia*, Perry does not teach or suggest using a "hydrogen-only" plasma for a chemical etch.

Claims 2-4 and 5-20 depend on claim 1 and are therefore patentable for at least the same reasons as claim 1.

Independent claim 21, as amended, recites "chemically etching, *in situ*, said oxide film in said gap with an HDP etching process with a hydrogen-only plasma." Thus, claim 21 is patentable over the cited references for reasons similar to claim 1.

Claims 22-30 depend on claim 21 and are thus patentable for at least the same reasons as claim 21.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a).

New Claims

Claim 31 has been added and recites, in part, "chemically etching said oxide film in said gap with a hydrogen-based plasma". Support is found in Applicants' specification, including at page 10, line 22 to page 11, line 1. Thus, no new matter is added.

As discussed above, Perry discloses using a hydrogen bromide gas with a chlorine gas for plasma etching and also an etching plasma containing gases such as C₂F₆, CF₄ or CHF₃. The hydrogen bromide gas with a chlorine gas (HBr/Cl₂) is used for etching polysilicon over oxide. (Perry, Figs. 5, 7, 9E, 9F, 10E, 10F, and accompanying text). It is well known in the art to use HBr/Cl₂ to etch silicon trenches for increased selectivity in etching the polysilicon and to not etch silicon oxide. (See, e.g., ULSI Technology, 1st Ed., 1996, by C.Y. Chang and S.M. Sze at pp. 354 and Silicon Processing for the VLSI Era, Vol. 1, Process Technology, 1st Ed., 1986 by S. Wolf and R.N. Tauber at pp. 557-558). The characteristics of an HBr/Cl₂ plasma do not allow a silicon oxide etch. Thus, the plasma etching in Perry is not to chemically etch oxide, as recited in claim 31, but rather to etch polysilicon.

Accordingly, Applicants believe claim 31 is also patentable over the cited references.

Claims 32 and 33 recite that the oxide is a doped oxide and an undoped oxide, respectively. Support for this is found in Applicants' specification at page 10, line 22 to page 11, line 1. Thus, no new matter is added.

Because claims 32 and 33 depend on claim 31, claims 32 and 33 are patentable for at least the same reasons as claim 21.

MacPHERSON, KWOK CHEN
& HEID LLP
2402 MICHELSON DRIVE
SUITE 210
IRVINE, CA 92612
(949) 752-7040
FAX (949) 752-7049

CONCLUSION

For the foregoing reasons, Applicants believe pending Claims 1-4 and 6-33 are allowable, and a notice of allowance is respectfully requested. If the Examiner has any questions regarding the application, the Examiner is invited to call the undersigned Attorney at (949) 752-7040.

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450, on September 10, 2003.



Sandy Kim

September 10, 2003

Respectfully submitted,



Tom Chen
Attorney for Applicant(s)
Reg. No. 42,406

MacPHERSON, KWOK CHEN
& HEID LLP
2402 MICHELSON DRIVE
SUITE 210
IRVINE, CA 92612
(949) 752-7040
FAX (949) 752-7049